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AUTHOR Wallace, Stephen R.; And Others
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ABSTRACT

This study explored whether the addition of visual examples through laser disc instruction influenced the learning and application of convergent and divergent questioning techniques and wait-time by preservice elementary education teachers during their clinical experience. The study compared the difference in the frequency of convergent and divergent questions asked and the length of wait-time I (the initial wait-time when an instructor waits for the first response) and wait-time II (the total time a teacher waits for a class to respond to the same question) between a control group of 28 subjects and a treatment group of 25 subjects. The control group learned questioning and wait-time use through typical verbal and written procedures. The treatment group learned in the same way but also received additional examples of question types and wait-time using a laserdisc format. Both groups participated in microteaching instruction during their clinical experience. An analysis of the frequency of convergent and divergent questions asked by the preservice teachers and the length of wait-time was conducted to determine the added benefit of the laser disc instruction. Results indicated that the use of laser disc materials did not significantly increase preservice teachers' use of divergent questions over convergent questions. An appendix contains a taxonomy outline. (Contains 11 references.) (JB)

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The Effect of Preservice Laserdisc Presentation of Question Types and Wait-time Use on Questioning and Wait-time Use in Clinical Experiences

Stephen R. Wallace, Thomas E. Thompson, Beth A. Wiegmann
Northern Illinois University

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Running head: QUESTION TYPE AND WAIT-TIME

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INTRODUCTION

Purpose of the research. The purpose of this research was two-fold. The first was to acquire additional knowledge of factors that may influence the learning and application of questioning techniques by preservice teachers during their clinical experience. The second was to add to the existing body of literature on questioning techniques and the visual presentation of material.

Problem under investigation. This study centers around increasing the effectiveness and efficiency of elementary science methods instruction given the limited time constraints typical of most teacher education programs. This study examined the effect of visual examples of classroom questioning strategies on the frequency of convergent and divergent questions asked, and the length of wait-time used by preservice elementary education science students. The independent variable investigated was the type of instruction presented. The dependent variables were the frequency of convergent and divergent questions asked and the length of wait-time I and II.

Hypotheses. The hypotheses were that students instructed with the additional use of a laserdisc presentation will decrease the frequency of convergent questions asked while increasing the frequency of divergent questions asked, and there would be an increase in the length of wait-time I and II. The null hypothesis, then, was that there should be no significant difference in the frequency of convergent and divergent questions asked and the length of wait-time

I and II between the control group (instructed with a traditional recitation method) and the treatment group (instructed with a traditional recitation method plus the use of a laserdisc).

Significance to education. This study was significant to teacher education for a variety of reasons. The first was that it added to the body of knowledge on questioning techniques. Second, it examined the use of visual examples for classroom instruction. A benefit from the use of laserdisc was the depth of processing the preservice students were willing to undergo to grasp the significance of question type and wait-time use. The laserdisc presentation allows for rapid access of appropriate modeling for clarification of any misconceptions the students might have. While this study doesn't articulate a new perspective, it may add to or contradict evidence gathered so far concerning the ability of preservice teachers to identify and use convergent and divergent questions, and to increase the length of wait-time I and II.

LITERATURE REVIEW

Over the past twenty years there have been a number of studies investigating the use of different questioning strategies and wait-time use by preservice and inservice teachers (Rowe, 1987; Wilen, 1991). While the research to date was inconclusive on the connection between the type of questions asked by the teacher and the level of student achievement, the research strongly suggested that teachers

typically ask cognitively low-level questions and students typically respond with cognitively low-level answers. While different classification systems for questioning strategies currently exist (Kindsvatter, Wilen & Ishler, 1988), there are common threads between them for defining low-level and high-level questions. Generally, low-level questions are defined as those that are convergent and designed to assess basic knowledge and skills. Higher-level questions are considered divergent and require critical thinking skills to synthesize and evaluate information. The optimal frequency of convergent to divergent questions isn't known (Gall & Rhody, 1987). Some researchers (Gall & Rhody, 1987; Wilen, 1991) suggest that learners need repeated opportunities to contemplate and respond to more higher-level questions in an effort to develop critical thinking skills.

A key to the development of critical thinking is the amount of time a teacher waits for learners to think. Wait-time research conducted by Rowe and others (DeTure, 1979; Rowe, 1974, 1987; Tobin, 1980, 1987) indicated that the duration of the pause between the end of a teacher's question and the beginning of the student's response or teacher's redirection (called wait-time I) and the length of pause after the student's response (wait-time II) had a profound effect on both students and teachers. A closer examination by Rowe (1974) indicated most teachers used an average wait-time I and II of 0.9 seconds. The most effective length of wait-time has been identified as

being around three seconds for both wait-time I and II. With a three second wait-time students and teachers had enough time to begin engaging in higher-levels of thinking and deeper processing. As a result, teachers showed greater flexibility, eliciting more clarification's and elaboration's from the students. The students exhibited increased speculative thinking, increased length of response, and more confidence. The research indicated that an appropriate use of wait-time I and II and increasing the number of divergent questions asked provided students with increased opportunities to participate in critical thinking and reasoning.

Research in teacher training has identified a variety of instructional improvement techniques that increased the use of divergent questioning strategies and extended wait-time used by preservice and inservice teachers. Wilen (1991) suggested that effective teacher education practices appropriate for improving questioning and wait-time techniques included: peer observation, instructor modeling, microteaching, observation instruments, minicourses, and coaching. DeTure (1979) found that preservice elementary teachers exposed to videotaped models of teachers clearly demonstrating three second wait-times extended their own wait-times toward the criterion level of three seconds. Rowe (1987) stated that the best way to ensure that teachers acquire and transfer three second wait-times to the classroom was by transcribing audio tapes as part of a teach-transcribe-reteach cycle.

METHODOLOGY

The experimental design for this study consists of comparing the difference in the frequency of convergent and divergent questions asked and the length of wait-time I and II between a control group of subjects and a treatment group of subjects.

Materials. Both the control group and the treatment group were verbally instructed on the use of questioning strategies and wait-time. The taxonomy used to classify question type was adapted from Weigand (1971), a derivation of the Aschner-Gallagher System. The question taxonomy classified questions into one of six categories. The categories were managerial, rhetorical, cognitive memory, convergent, divergent, and evaluative (see Appendix A for an outline of the question taxonomy presented to both groups).

A convergent question was operationally defined as a question that is narrow, but one that required the child to recall facts in order to construct an answer. A convergent question required one to identify relationships, explain, and compare or contrast to arrive at one right or best answer. A divergent question was operationally defined as one that permitted the child to respond with more than one acceptable answer. Here the child was required to create, synthesize, infer, predict, or hypothesize.

Wait-time use was adopted from Carin (1993)—the required text for the course. Wait-time I was operationally defined according to Carin (1993) as "the initial wait-time when an instructor waits for the

first response" (p. 126). Wait-time II was also operationally defined according to Carin (1993) as "the total time a teacher waits for a class to respond to the same questions" (p. 126).

In addition, the treatment group was presented visual examples of science teachers asking children questions in an elementary school setting. The visual examples were presented in a laserdisc format obtained from a teacher education series developed by Thompson (1993). Barcoded examples of questions classified according to Weigand's (1971) taxonomy and the appropriate use of wait-time I and II were presented to the study participants after the recitation.

Sample. The subjects were 53 undergraduate junior and senior ranked elementary education students randomly assigned to and enrolled in an elementary science methods course at a midwestern university. There were 28 subjects in the control group and 25 in the treatment group.

Procedure. The procedures were as follows. The subjects were assigned to one of two sections of an elementary science methods course. The control group consisted of one section instructed on questioning and wait-time use through verbal and written procedures typical of a one semester comprehensive course on elementary science methods. The treatment group consisted of another section of the same course that was instructed in the same manner as the control group. The treatment group also received additional examples of question types and wait-time using a laserdisc format. Both groups

participated in microteaching instruction during their clinical experience (part of their normal program). Students recorded audio tapes of the microteaching sessions. Each student transcribed and coded their own tape. The transcripts were then evaluated for the preservice teacher's accuracy of question classification and calculation of wait-times. An analysis of the frequency of convergent and divergent questions asked by the preservice teachers and the length of wait-time was conducted to determine if there was an added benefit to the inclusion of the laserdisc modeling of wait-time and questioning.

Instruments. The instruments used to measure the frequency of convergent and divergent questions and the length of wait-times were audio tapes of the microteaching assignment during the clinical experience and the self-coded transcripts of the microteaching experience.

RESULTS AND DISCUSSION

All of the question classification data from the subjects were used in the analysis. A random sample of seven written transcripts of the audio taped microteaching sessions from each group were compared with the actual audio tapes to verify the accuracy of the transcriptions. There was no significant difference between the audio tapes and the transcripts.

Results. The control group asked an average of 9.42% convergent questions and 16.81% divergent questions. The treatment group averaged 13.12% convergent questions and 12.48% divergent questions asked, as shown in Table 1. There was no significant difference observed between the frequency of divergent questions asked and convergent questions asked between the two groups, as shown in Table 2 and Table 3.

TABLE 1.

Descriptive Statistics Comparing The Control Group to the Treatment Group

	Control Group (n = 28)		Treatment Gp (n = 25)	
	Convergent	Divergent	Convergent	Divergent
Minimum	0	0	0	0
Maximum	9	14	19	9
Mean	2.6	5.1	3.8	3.1
Variance	5.7	10.9	15.9	6.8
Stand. Dev.	2.4	3.3	4.0	2.6
Stand. Error	0.45	0.62	0.80	0.52
Total	73	142	96	77
% of Total	9.42	16.81	13.12	11.38

TABLE 2.

Independent Samples t-test on the Frequency of Convergent Questions Asked

Group	N	Mean	SD
Control	28	9.42	8.65
Treatment	25	13.12	9.31

Separate variances t = -1.49 df = 49.2 prob = 0.071

Pooled variances t = -1.50 df = 51 prob = 0.070

TABLE 3.

Independent Samples t-test on the Frequency of Divergent Questions Asked

Group	N	Mean	SD
Control	28	16.81	10.54
Treatment	25	12.48	11.38

Separate variances t = 1.43 df = 49.2 prob = 0.080

Pooled variances t = 1.44 df = 51 prob = 0.078

The analysis of the length of wait-time I and II was inconclusive due to unexpected inaccuracies in measuring the length of wait-time from the audio tapes. The establishment of any significance test was deemed unattainable, as equipment for an

accurate analysis was not available. The audio-tapes were observed for trends in the length of wait-time for the preservice teachers. Those observations indicated that the majority of the wait-time I and II lengths were estimated to be under 2 seconds. It appeared that the treatment group did extend wait-time I and II beyond that of the control group, but not to the expected 3 seconds length.

Discussion. The hypotheses investigated in this study stated that students instructed with the additional use of a laserdisc presentation will decrease the frequency of convergent questions asked while increasing the frequency of divergent questions asked, and there would be an increase in the length of wait-time I and II. In analyzing the convergent and divergent ratios the data indicated the null hypothesis should be retained at $\alpha = 0.05$ ($t = -1.49$, $df = 49.2$, $p = 0.071$, one-tailed for the frequency of convergent questions asked; $t = 1.43$, $df = 49.2$, $p = 0.080$, one-tailed for the frequency of divergent questions asked). Observations of wait-time indicated there was a slight increase in wait-time for the treatment group. However, the conclusion is not supported by statistical analysis. The results indicated that the use of laserdisc materials did not significantly increase preservice teachers use of divergent questions over convergent questions.

During the class discussions the preservice teachers indicated that they understood the questioning classification system and questioning strategies. They indicated they felt confident in their

ability to use a variety of questions during their teaching experience. The results, however, suggest that in practice and during reflection preservice teachers did not fully understand the questioning classification system, regardless of the instruction method.

Plausible explanations for a lack of understanding center around the selection of the taxonomy system used and the laserdisc that was presented. Anecdotal observations and comments by students indicated that the Weigand classification system, a derivation of the Aschner-Gallagher System, was confusing. The treatment group spent more time focusing on the calculation of wait-time than on classifying questions when shown the laserdisc presentation. It appears that the depth of processing for wait-time interfered with the preservice students ability to comprehend the question classification system during instruction. Not until the students had to apply the taxonomy did they realize that they did not fully understand it. In addition, the laserdisc used was not specifically produced to focus on the use of questions. This may have contributed to any lack of significance.

Questions arising from this study include: What are more effective uses for laserdisc presentations of questioning skills? What is the best question taxonomy to use for the most effective teaching? If laserdisc presentation of question types and wait-time use are effective, can computer-aided instruction modules (level III) be developed to free up time in the classroom for other activities? And, what are more effective ways to calculate wait-time?

Appendix A

Question Taxonomy Outline

- Question Taxonomy
  - ◊ Managerial
    - Often used to maintain control
    - Example: "Would you take out your pencil?"
  - ◊ Rhetorical
    - Often used to maintain control
    - Example: "April—two plus two is four, right?"
  - ◊ Cognitive memory
    - Narrow questions that are limited to the lowest level of thinking
    - Example: "What are the three categories of rocks?"
      - Name
      - Yes/No responses
      - Identify
      - Recall
      - Describe
      - Define by rote
  - ◊ Convergent
    - Narrow questions, but require child to recall facts in order to construct a response
    - Example: "What is the difference between an inference and a prediction?"

- Identify relationships
- Explain
- Compare/Contrast

◊ Divergent

- Permits more than one acceptable response
- Example: "In what ways could you use the school grounds for science activities?"
  - Create
  - Synthesize
  - Infer
  - Predict
  - Hypothesize

◊ Evaluative

- Causes children to organize their knowledge, formulate an opinion, and take a self-selected position
- Example: "Which brand of microscope is the best to use with elementary children?"
  - Develop criteria
  - Judge
  - Defend a position
  - Justify a choice
  - Evaluate

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